AMENDED TRANSLATION - FOR EXAMINATION

Method for reinitializing count of thread reel length

The present invention relates to the technical field of textile machinery for converting yarn.

More precisely, the invention has an application in the area of winding which involves applying a reel that is being formed on a powered take-up cylinder in order to ensure both rotational driving of the reel and take-up of the yarn. Generally speaking, the reel on which the yarn is wound is slaved to a moving assembly that grips the central tube between rotating centering devices, enabling it to rotate around its axis whilst pushing the reel against the powered cylinder.

Devices used in order to determine precisely the quantity of yarn wound onto each reel are known. This information is useful in order to manage downstream processes that are likely to reuse such reels. It should also be noted that these devices can be used in order to produce reels of a predetermined length. In this case, the device(s) can be connected to means capable of warning the operator that the programmed meterage has been reached so that the operator can perform a reel change, i.e. remove the reel and restart winding on an empty holder. The device may also be connected to means making it possible to interrupt winding once the programmed winding has been achieved and wait for an operator. The device may also be connected to means of performing an automatic reel change once the programmed meterage has been reached.

AMENDED TRANSLATION - FOR EXAMINATION

The aim is therefore to produce reels having a perfectly equal length, for example so that all the warp yarns are identical, without knots or losses of bottoms of reels.

The monitoring devices are, for instance, based on measuring the speed of the take-up components of the machine or of various means that combine various spooling parameters in order to perform meterage calculations.

Patent FR 2.123.176, for example, discloses a technical solution that relates to a device based on counting pulses output by a sensor that detects the rotation of a shaft, the velocity of which represents the feed speed of the yarn.

Patent FR 2.309.832 describes a system based on counting the pulses generated by a sensor that detects rotation of the reel and an electronic circuit that calculates the quantity of yarn wound around the circumference of the reel during each revolution of the latter.

Patent FR 2.517.657 relates to a technical solution that is equivalent to that defined above and includes means capable of compensating for measurement errors due to slippage.

These various metering solutions propose starting from a manual reset action or starting from completion of metering of the previous reel.

However, such solutions do not take into account events that are likely to occur during winding. These events may, for instance, be the result

AMENDED TRANSLATION - FOR EXAMINATION

of a production stoppage following, for example, a yarn breakage or some other technical problem on the machine.

In certain cases the operator can decide to continue production on the same reel without resetting the counter and metering must continue until the determined meterage is reached. This applies, for example, in the case of breakage of the yarn if it is possible to reattach the latter.

In other cases the operator may decide to restart production on a fresh reel. In this case it is generally necessary to lift off and discard the reel and to fit an empty tube in order to restart production. The meterage counter of the station must then be reset by means of a contactor connected to the station so that such metering restarts afresh.

The technical problem of resetting metering of the length of reels is therefore important. Simple reset systems have been proposed, as is apparent, for example, from the teaching of the above-mentioned patents. For example, the operator may have or may not have to actuate a reset pushbutton when restarting, depending whether or not the operator continues or not on the same reel. It is apparent that this solution depends directly on the alertness of the operator. It is therefore not possible to exclude the possibility of errors of judgment.

Another example of a problem that occurs is if the operator performs a reset without replacing the full reel by an empty tube. In this case, the full reel continues to expand and may exceed the capacity of the system and damage it.

AMENDED TRANSLATION - FOR EXAMINATION

Relatively complex electric or electronic systems have been suggested in order to avert such risks of error or omission by the operator.

For example, machines equipped with an electronic monitoring system connected to an automatic winding switch-off system are known. The counter is reset automatically as soon as a reel is finished. This arrangement prevents the risk of forgetting to perform a reset before restarting. However, this solution does not work if winding is interrupted manually or if winding is interrupted before the reel is finished.

Automatic reset when stoppage of the winding system is detected has also been proposed. However, a reset is not appropriate if production is continued on the same reel.

Other enhancements have been suggested in order to detect replacement of the reel by an empty tube. For example, a switch located on the assembly that supports the reel or its tube detects manipulation of the holder that is characteristic of replacing the full reel by an empty tube.

Another means involves installing a switch in the means used to secure the reel in order to detect its presence and temporary absence when replacing a full reel by an empty tube. Such means are generally expensive and difficult to adjust. In addition, they perform a reset if movements that are characteristic of replacement of a full reel by an empty tube are detected, even if such replacement did not actually take place.

The invention has set itself the object of overcoming these drawbacks in a simple, dependable, effective and efficient manner.

AMENDED TRANSLATION - FOR EXAMINATION

The problem that the invention intends to solve is to ensure resetting of metering of the length of a reel of yarn with the aim of eliminating any uncertainty associated with the operator, to completely automate the resetting of metering in order to simplify the job of said operator and to optimize the operator's intervention time at each station whilst excluding the possibility of producing reels that are too short.

As already stated, the invention has an advantageous application in particular in the case of a winding device which involves applying a reel that is being formed on a powered take-up cylinder that ensures both rotational driving of the reel and take-up of the yarn.

According to the invention, the counter is reset on the basis of the measured diameter of the reel that is being formed after it has been started.

In order to solve the problem in question, a method has been designed and perfected whereby:

- the rotation speed obtained with the empty reel is recorded beforehand;
- after start-up, the rotation speed of the reel that is being formed is measured, this speed corresponds to the maximum speed reached at the end of the start-up acceleration phase and at the start of the gradual slowdown phase after the winding phase and this speed is compared to that obtained when the reel was empty;
- if the rotation speed measured after start-up is substantially equal to (or greater than) the rotation speed obtained when the reel was empty, length metering is then reset;

AMENDED TRANSLATION - FOR EXAMINATION

- if the speed after start-up is substantially less than the rotation speed that corresponds to an empty tube, metering is resumed from the point where it stopped.

The speed after start-up is measured immediately after the acceleration phase following start-up. In practice, this speed corresponds to the maximum speed reached at the end of the start-up acceleration phase and at the start of the gradual slowdown phase after the winding phase.

Counter reinitialization can be a simple zero reset.

To obtain improved metering accuracy, this reset may involve resetting the counter to the winding length recorded during the acceleration phase, estimated, for example, by counting the number of revolutions that the tube actually made during this phase.

Building on this basic concept, several enhancements can be envisaged.

According to a first enhancement, the rotation speed is measured continuously or at regular intervals during production.

According to this first enhancement:

- the rotation speed measured immediately before a production stoppage is stored.
- the rotation speed after restarting is measured and compared firstly to the rotation speed obtained with an empty reel and secondly to the speed stored immediately before the stoppage, so that:

- if the rotation speed measured after restarting is substantially equal to (or greater than) the rotation speed obtained when the reel was empty, length metering is reset;
- if the rotation speed measured after restarting is substantially equal to the rotation speed obtained immediately before the stoppage, length metering is not reset and metering resumes from the point at which it stopped;
- if the rotation speed measured after restarting is less than the rotation speed obtained when the reel was empty and greater than the rotation speed obtained immediately before the stoppage, length metering is not reset and metering resumes from the point at which it stopped and an alarm is triggered in order to indicate risk of abnormal metering.

According to this enhancement, the following test may usefully supplement this process:

- if the rotation speed measured immediately before the stoppage is substantially equal to the rotation speed obtained when the reel was empty, length metering is reset and an alarm is triggered in order to indicate risk of abnormal metering.

According to a second enhancement, the rotation speed equivalent to the final meterage of a correctly wound reel and/or the rotation speed equivalent to the maximum diameter of the reel accommodated by the winding system is recorded beforehand.

AMENDED TRANSLATION - FOR EXAMINATION

According to this second enhancement:

- if the rotation speed measured after restarting and/or during winding is substantially equal to or less than the rotation speed equivalent to the final meterage of a correctly wound reel and/or the rotation speed equivalent to the maximum diameter of the reel accommodated by the winding system, winding is interrupted and an alarm is triggered in order to indicate that the reel reached an excessively large diameter.

According to this second enhancement, the following test may usefully supplement this process:

- if the rotation speed of the reel immediately before stoppage on reaching the programmed meterage differs from the rotation speed equivalent to the final meterage, an alarm is triggered in order to indicate that the final diameter of the reel does not match the expected final diameter.

According to another enhancement, a table containing the rotation speed as a function of meterage reached for a correctly wound reel is recorded beforehand, so that, if the rotation speed measured at any instant during winding differs from the rotation speed equivalent to the meterage reached at the time in question for a correctly wound reel, an alarm is triggered to indicate that the diameter of the reel does not match the expected diameter.

In order to implement the method, regardless of the particular embodiment, the device comprises a least one means capable of measuring the rotation speed of the reel, e.g. a sensor, that outputs one or more pulses

per revolution so that the rotation speed can be deduced from the frequency of said pulses or from the time that elapses between said pulses.

According to another characteristic, the device comprises electric or electronic means capable of performing the operations described above and of triggering alarms in the form of, for example, one or more visible and/or audible signals. These means may be linked to a display that indicates the causes of the alarm. These means may be a computer, an automaton or an electronic logic circuit, possibly combined with other means of processing and/or diagnostics.

The invention is explained below in greater detail, reference being made to the accompanying drawings in which:

- Figures 1, 2 and 3 are perspective views showing the principle used to measure the rotation speed of the reel during the following phases:
  - Figure 1: start-up of reel on an empty tube;
  - Figure 2: stoppage and restarting of reel during winding;
  - Figure 3: end of winding on reaching programmed meterage;
- Figure 4 is a diagram showing acceleration and then slowdown of the speed of the reel at the time of start-up;
- Figure 5 is an algorithm that describes the invention;
- Figure 6 shows an algorithm that describes the invention in accordance with a first enhancement;
- Figure 7 shows an algorithm that describes the invention in accordance with a second enhancement.

AMENDED TRANSLATION - FOR EXAMINATION

In these various Figures, identifier (F) denotes the yarn, (1) denotes the take-up cylinder, (2) denotes the tube of the reel, (3) denotes winding of the yarn, (4) denotes the yarn guide and (5) denotes the means of measuring the angular velocity of the reel (2).

According to the basic principle of the invention, one uses measurement of the rotation speed of reel (2) which is a quantity that varies depending on the meterage of yarn that has been wound. Thus, after the start-up acceleration phase, for a given yarn feed speed and a given angle of intersection, the rotation speed of reel (2) is substantially inversely proportional to the circumference of the reel and hence its diameter.

As a result, after the start-up acceleration phase, for a substantially constant yarn feed speed and angle of intersection, the rotation speed of the reel peaks when the tube is empty and decreases gradually as the circumference of the reel increases.

According to the invention, the rotation speed (Vo) obtained when the tube (2) is empty is measured beforehand.

At the time of restarting, the rotation speed (Vd) measured after the reacceleration phase (A) is compared to the rotation speed (Vo) obtained when the tube was empty.

- If the rotation speed measured immediately after restarting is equal to (or greater than) (within a certain tolerance) the rotation speed obtained when the reel was empty, length metering is reset.

- If the speed after start-up is substantially less than the rotation speed that corresponds to an empty tube, metering is resumed from the point where it stopped (see algorithm in Figure 5).

The speed after start-up is measured immediately after the acceleration phase following restarting. In practice, this speed corresponds to the maximum speed reached at the end of the start-up acceleration phase and at the start of the gradual slowdown phase after the winding phase.

Counter reinitialization can be a simple zero reset.

To obtain improved metering accuracy, this reset may involve resetting the counter to the winding length recorded during the acceleration phase, estimated, for example, by counting the number of revolutions that the tube actually made during this phase.

According to a first enhancement, the rotation speed is measured continuously or at regular intervals during production (see algorithm in Figure 6).

In the event of a production stoppage, the rotation speed (Va) recorded before the stoppage is stored. On restarting, the rotation speed (Vd) is measured after restarting and compared firstly to the rotation speed (Vo) obtained with an empty reel and secondly to the rotation speed (Va) stored immediately before the stoppage. Using this measurement principle, there are several possibilities:

AMENDED TRANSLATION - FOR EXAMINATION

- if the rotation speed (Vd) measured after restarting is equal to (or greater than) (within a certain tolerance) the rotation speed (Vo) obtained when the reel was empty, length metering is reset;
- if the rotation speed (Vd) measured after restarting is equal to (within a certain tolerance) the rotation speed (Va) obtained immediately before the stoppage, length metering is not reset and metering resumes from the point at which it stopped;
- if the rotation speed measured after restarting is less than (within a certain tolerance) the rotation speed obtained when the reel was empty and greater than (within a certain tolerance) the rotation speed obtained immediately before the stoppage, length metering is not reset and metering resumes from the point at which it stopped but an alarm is output (risk of producing an excessively short reel).

This process may be usefully supplemented by an additional test.

- if the rotation speed (Va) measured immediately before the stoppage is equal to (within a certain tolerance) the rotation speed (Vo) obtained when the tube was empty, length metering is reset and the system outputs an alarm (risk of producing an excessively long reel).

According to a second enhancement, the rotation speed (Vp) equivalent to the final meterage of a correctly wound reel and/or the rotation speed equivalent to the maximum diameter of the reel accommodated by the winding system is recorded beforehand (see algorithm in Figure 7).

If the rotation speed (Vd) measured after restarting and/or during production is equal to or less than (within a certain tolerance) the rotation speed (Vp) equivalent to the final meterage of a correctly wound reel and/or

AMENDED TRANSLATION - FOR EXAMINATION

the rotation speed equivalent to the maximum diameter of the reel accommodated by the winding system, winding is interrupted. The system may output an alarm indicating that the maximum reel diameter was exceeded.

This process may be usefully supplemented by an additional test.

If the rotation speed (Va) of the reel immediately before stoppage on reaching the programmed meterage differs (positively or negatively) from the rotation speed (Vp) equivalent to the final meterage of a correctly wound reel, an alarm indicates that the final diameter of the reel does not match the expected final diameter.

By extension, one can store, in advance, for example in a table, the rotation speed as a function of the meterage reached for a correctly wound reel. If the rotation speed measured at any time during winding differs (positively or negatively) from the rotation speed equivalent to the meterage reached at that instant for a correctly wound reel, an alarm indicates that the progress in the diameter of the reel that is being wound does not match progress for the desired diameter.

According to the invention, in order to measure the rotation speed of reel (2), means of measuring (5) may consist, for example, of a magnetic, optical or other type of sensor that outputs one or more pulses per revolution. The rotation speed is deduced from the frequency of these pulses or from the time that elapses between these pulses.

AMENDED TRANSLATION - FOR EXAMINATION

The device comprises means of performing the measurements and processing routines stated above. These means may be printed circuit boards, logic circuits or automata, etc.

These means are capable of outputting alarms and may generate one or more visible or audible signals. The alarms may be identified by a combination of the various signals or by the different flashing rates, frequencies or codes of these signals. The alarms may be linked to a display that indicates the reason for the alarm. Similarly, these alarms may be relayed over a network to an automaton of the machine or other production management system. Note that the alarms can be combined with any diagnostic means such as voltage detectors, yarn detectors, textile flaw detectors and, more generally speaking, any system that monitors production quality.

The various types of processing are performed on printed circuit boards (e.g. automaton) or are integrated and/or combined with other diagnostic means.

The advantages are readily apparent from the description.